

Population Response Modeling

Goal Project the relative differences in estimated NSO population performance among the various habitat reserve design scenarios given various assumptions about future habitat changes and barred owl impacts

Objectives To use a spatially-explicit population model to evaluate estimated spotted owl population responses to different reserve designs, habitat changes, and barred owl impacts

What is HexSim?

- ➔ It is a computer simulation model.
- ➔ It is useful for evaluating wildlife population responses to human activities.
- ➔ It is modern and sophisticated, but flexible and easy to use.
- ➔ It can be used with a large range of places, problems, and questions.

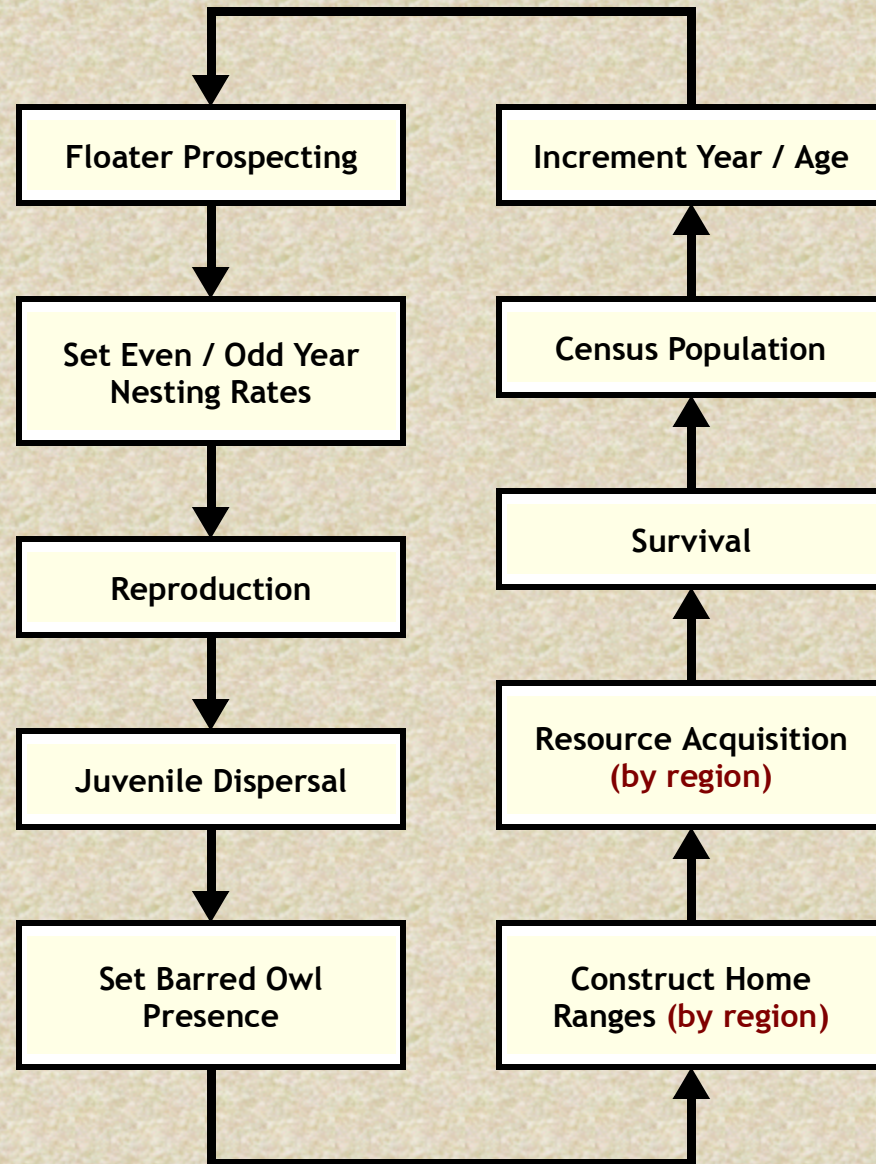
HexSim Inputs

- ➔ **Spatial Data.** Can be real or fabricated, one or multiple layers, static or time series...
- ➔ **Life History Data.** Can be real or fabricated or a hybrid. Data limits model complexity...
- ➔ **Disturbance Regimes.** Spatial, temporal, simple, complex, local, regional, etc...
- ➔ **Stochasticity.** Demographic, environmental, life stage-specific, spatially-distributed, etc...

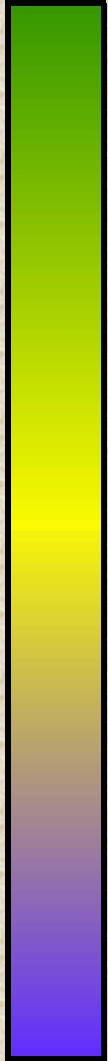
HexSim Outputs

- ➔ **Census Data.** Chronological records of user-defined population metrics.
- ➔ **Tabular Reports.** CSV files detailing observed vital rates, movements, interactions, etc.
- ➔ **Map-Based Reports.** Map files illustrating population performance and interactions.
- ➔ **Videos.** Movies showing movement, resource acquisition, occupancy by trait class, etc.

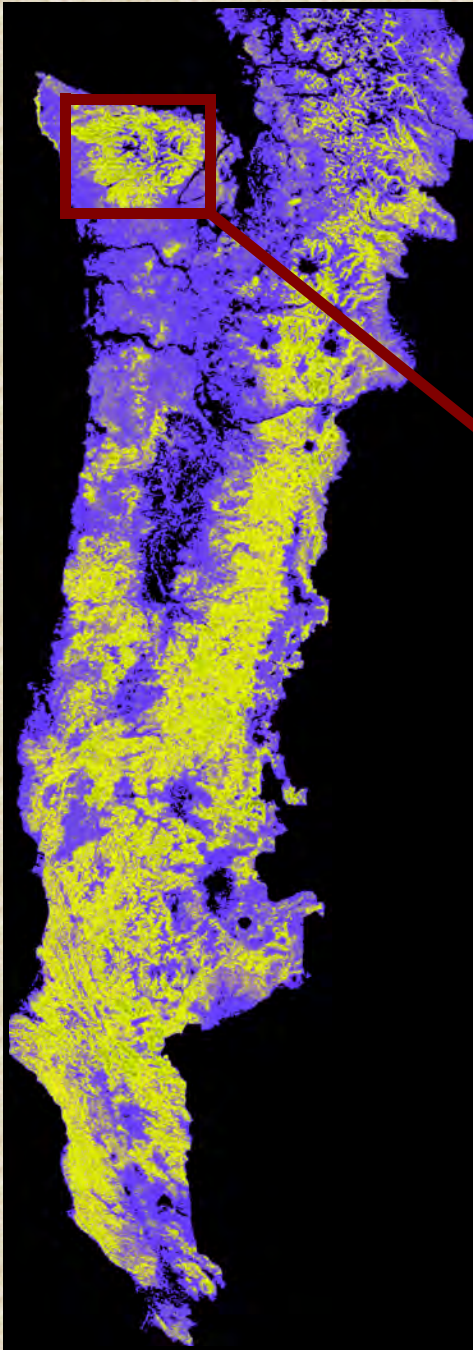
HexSim Spotted Owl Life Cycle



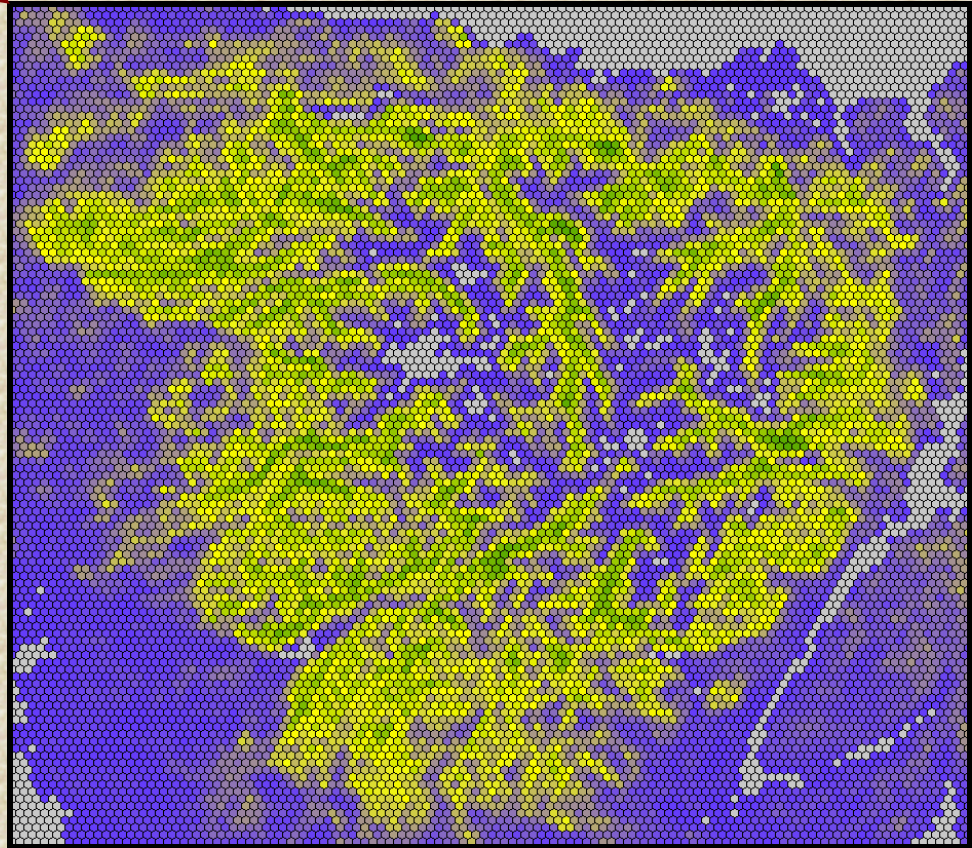
Highest
Quality



Lowest
Quality



MaxEnt Current Conditions Resource Map



Legend

- Large Cities
- Small Cities
- Major Highways
- US Highways
- Other Highways
- State Boundary
- Coastline

Demographic Study Areas

- Cle Elum
- Coast Ranges
- H.J. Andrews
- Hoopla
- Klamath
- Main
- NW California
- Olympic
- Rainier
- Simpson
- South Cascades
- Tye
- Warm Springs
- Wenatchee

Modeling Regions

- East Cascades North
- East Cascades South
- Inner California Coast Ranges
- Klamath East
- Klamath West
- North Coast Olympics
- Oregon Coast
- Puget Willamette East
- Puget Willamette North
- Puget Willamette West
- Redwood Coast
- West Cascades Central
- West Cascades North
- West Cascades South

Natural Resource Geospatial

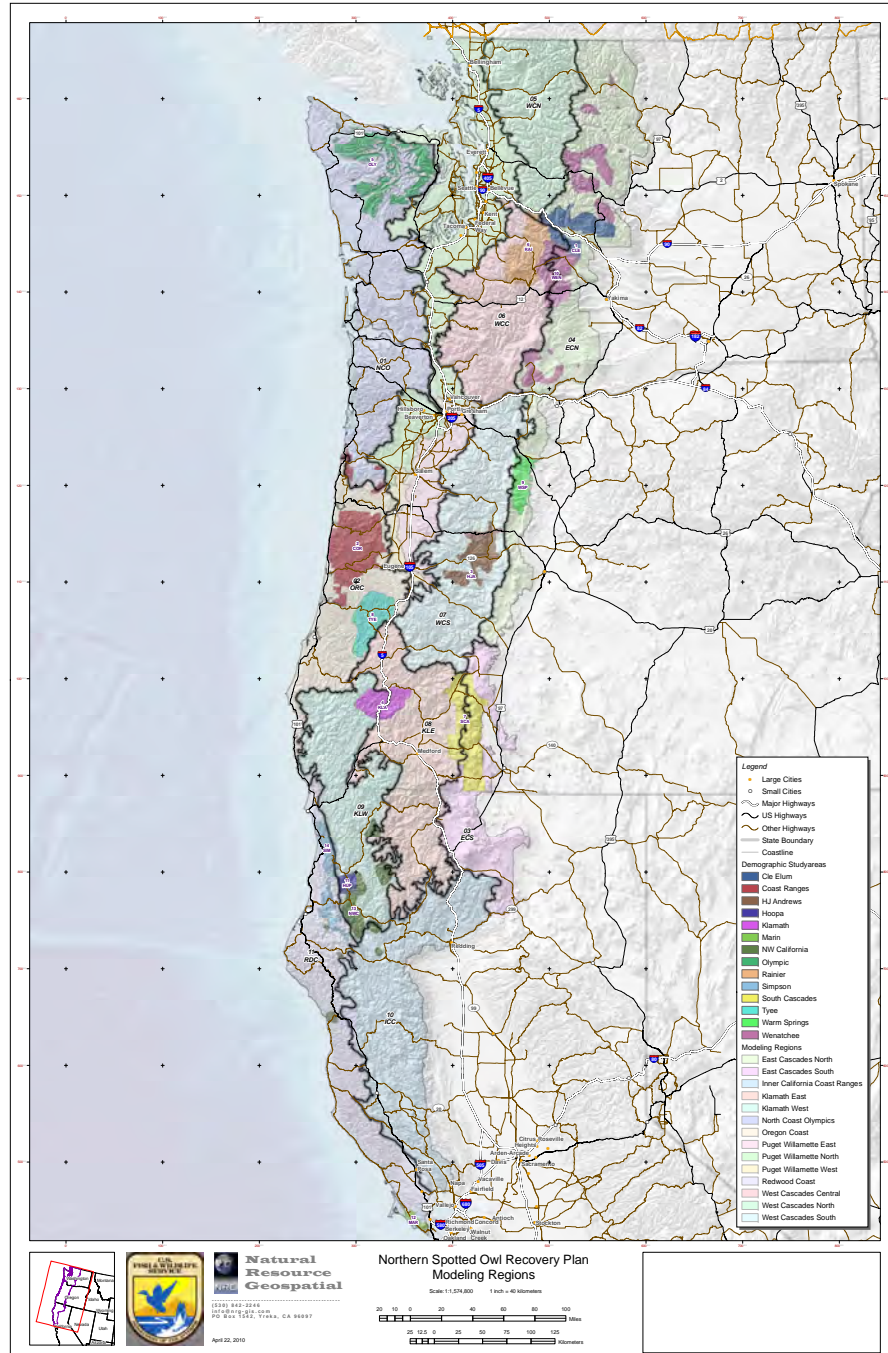
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Northern Spotted Owl Recovery Plan Modeling Regions

Scale 1:1,500,000 1 inch = 40 Kilometers

20 40 60 80 100 Miles
20 40 60 80 100 Kilometers

April 22, 2010



Baseline | Female Spotted Owls

Properties Range Data Traits Affinities Description

Range Spatial Data MaxEnt 2006 NSO Habitat

Range Barriers >>> None Selected <<<

hectares & meters hexagons

Maximum Range Area 259.8076 3.0000

Maximum Range Span 2000.0000 2.0000

Maximum Group Members 1

Hexagons Range-Eligible if Value is At Least 35.0000

Minimum Range Resource 105.0000

Floater Preemption of Group Resources (%) 0.0000

☐ Competitive Ability (%) 0.0000

Resource Targets

☐ Barred Owl Present
☐ Demographic Study
☐ Explored Area Rank
☒ Modeling Region
☐ Nesting
☐ Range Ranks
☐ Resource Class
☐ Stage Class
☐ Territory Status

Name	Rank	Target
Not In A Modeling Region	0	0
North Coast Olympics	0	1250
Oregon Coast	0	375
East Cascades South	0	750
East Cascades North	0	1000
West Cascades North	0	1250
West Cascades Central	0	1250
West Cascades South	0	375
Klamath East	0	375
Klamath West	0	375
Inner California Coast Ranges	0	375
Redwood Coast	0	250

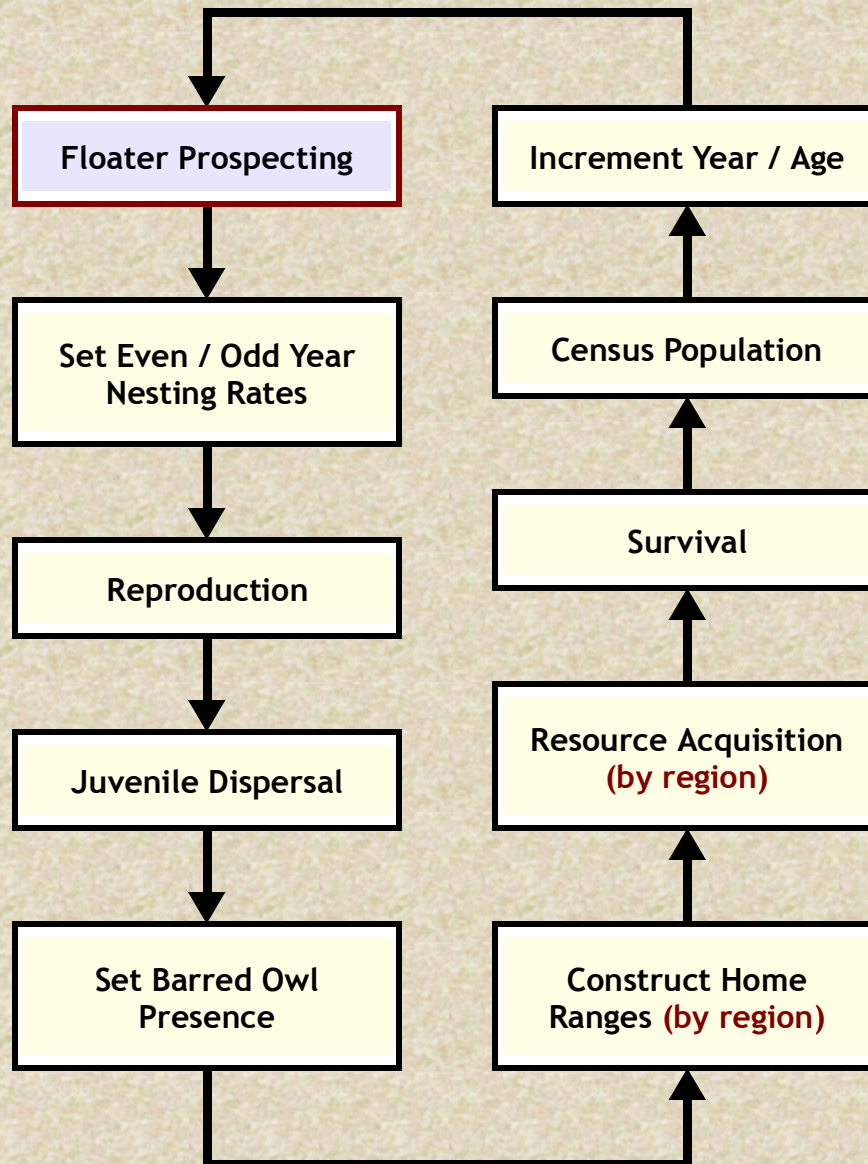
Import

Recover Close

Territory and Home Range Data

- Territory size small and constant (2-3 hexagons)
- Resources acquired from home ranges
- Resource targets stratified by region
- Resource targets mimic resource density
- Targets affect survival via acquisition classes

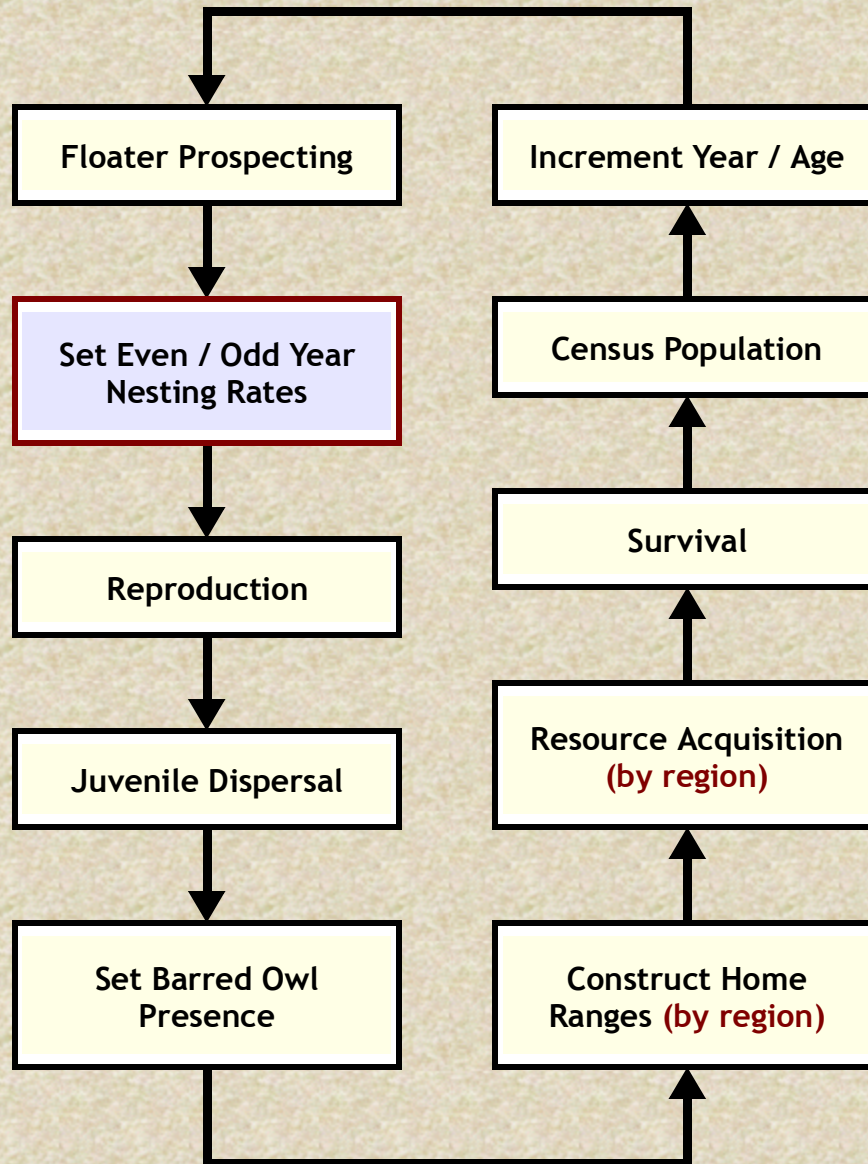
Floater Prospecting



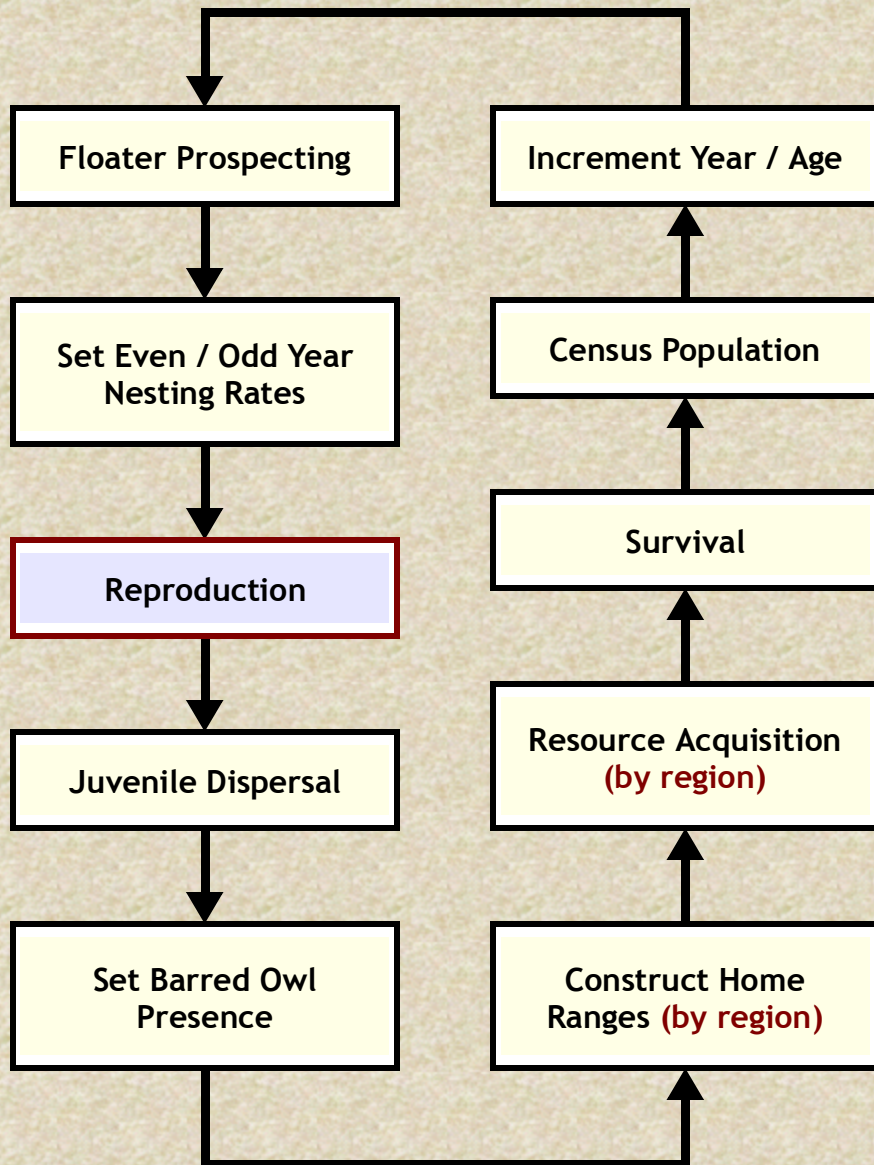
■ Applies to all non-territorial birds

■ Search area is 500 hexagons (43,300 ha)

Nesting Frequencies

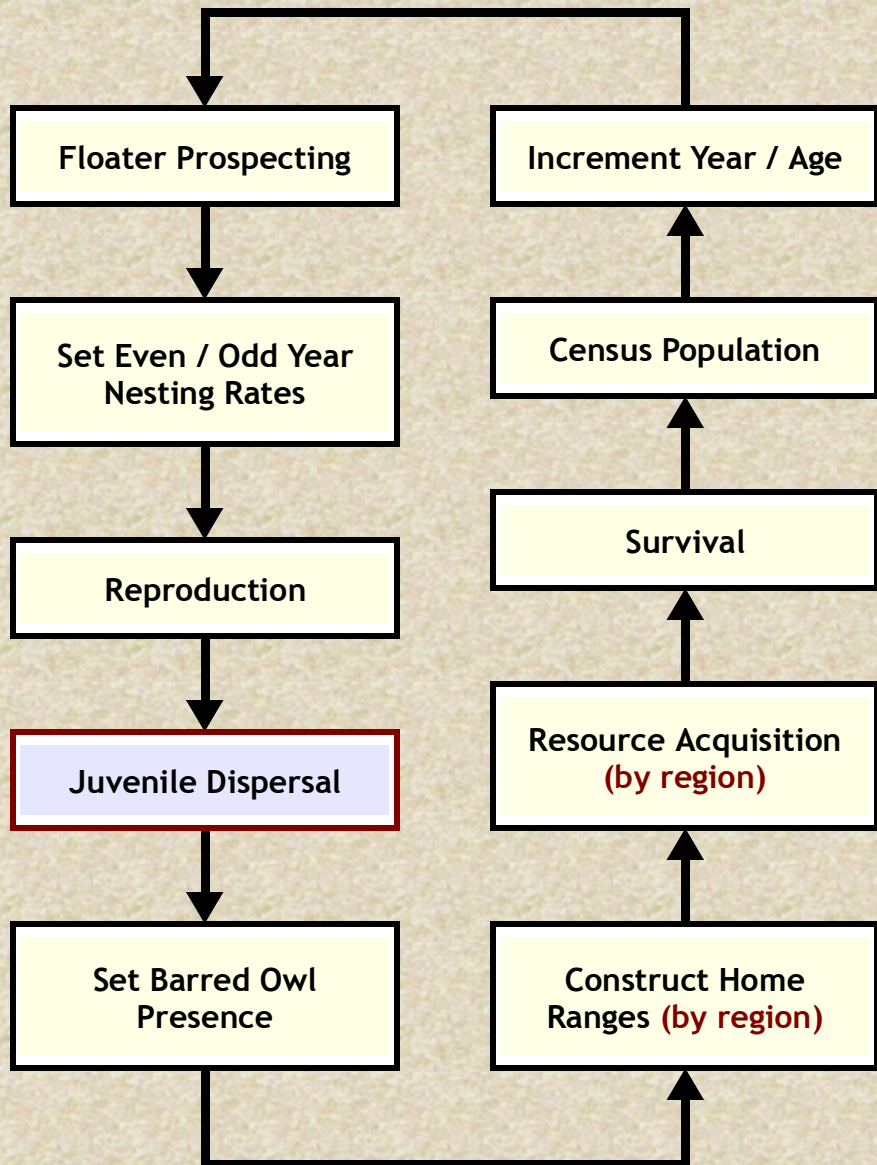


- In even years,
 $P(\text{nesting}) = 70\%$
- In odd years,
 $P(\text{nesting}) = 30\%$
- On average,
 $P(\text{nesting}) = 50\%$



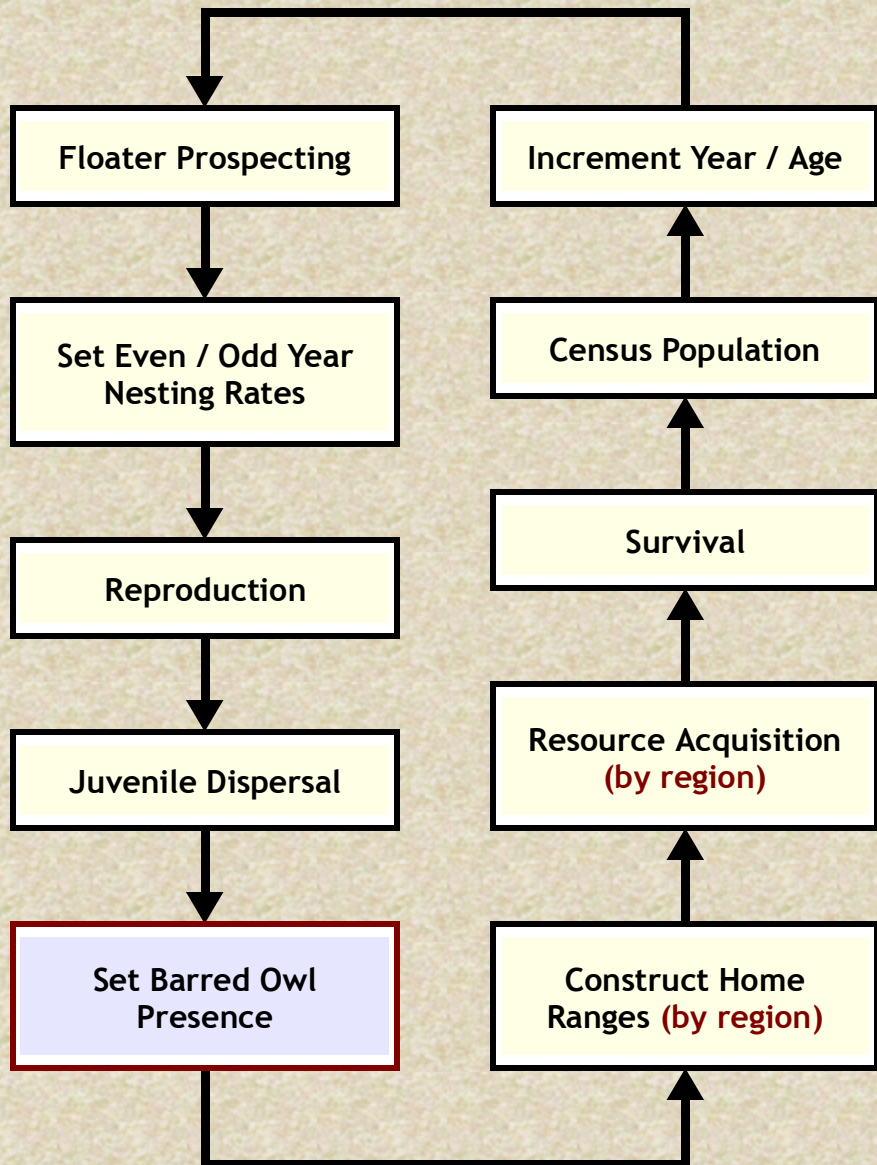
Reproduction

- Fecundities taken from Forsman et. al. (in press)
- *Assumptions:*
50/50 Sex ratio
Clutch size = {0, 1, 2}
 $P(1) = P(2)$
- Measured fecundities are females / female
- HexSim fecundities are females / nesting female



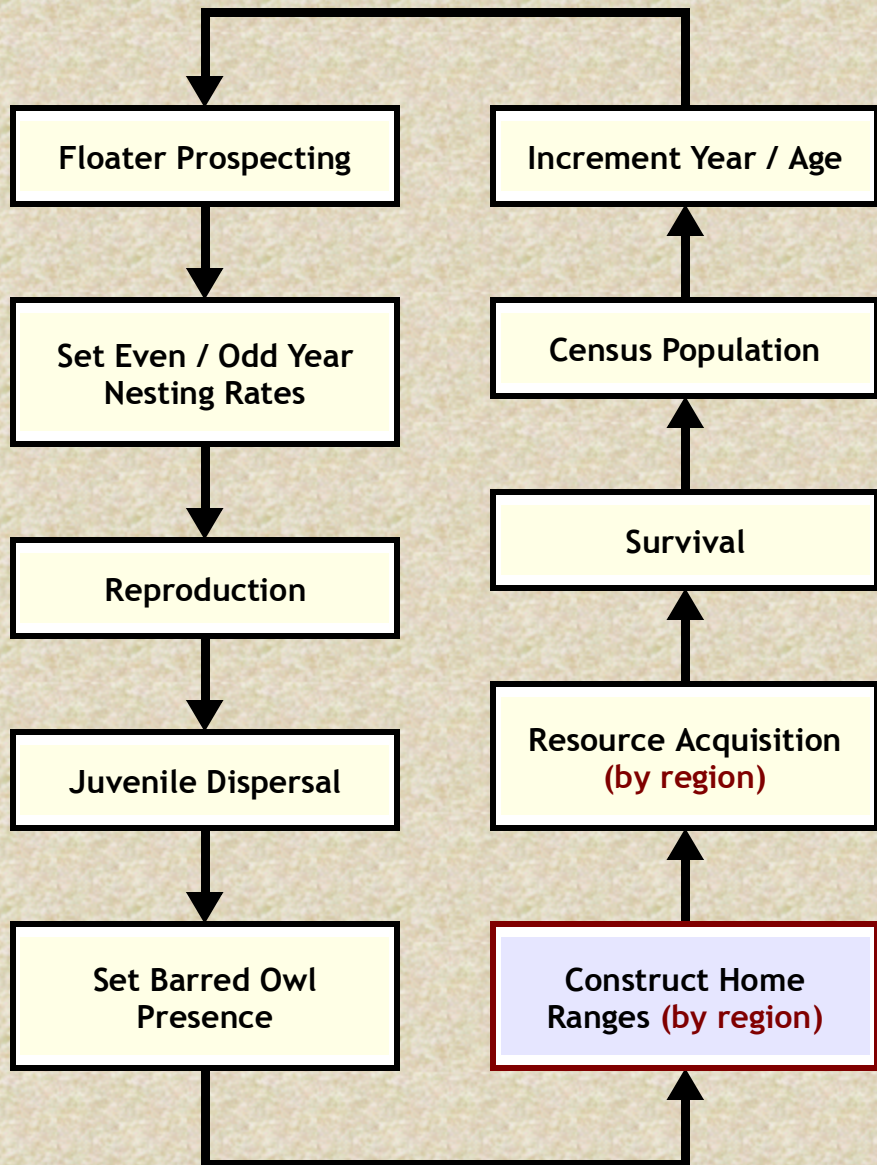
Juvenile Dispersal

- ❑ Dispersal only, no prospecting
- ❑ Move max of 250 hexagons (250 km)
- ❑ Stop if territory-quality resources are encountered
- ❑ Tendency to avoid very poor areas



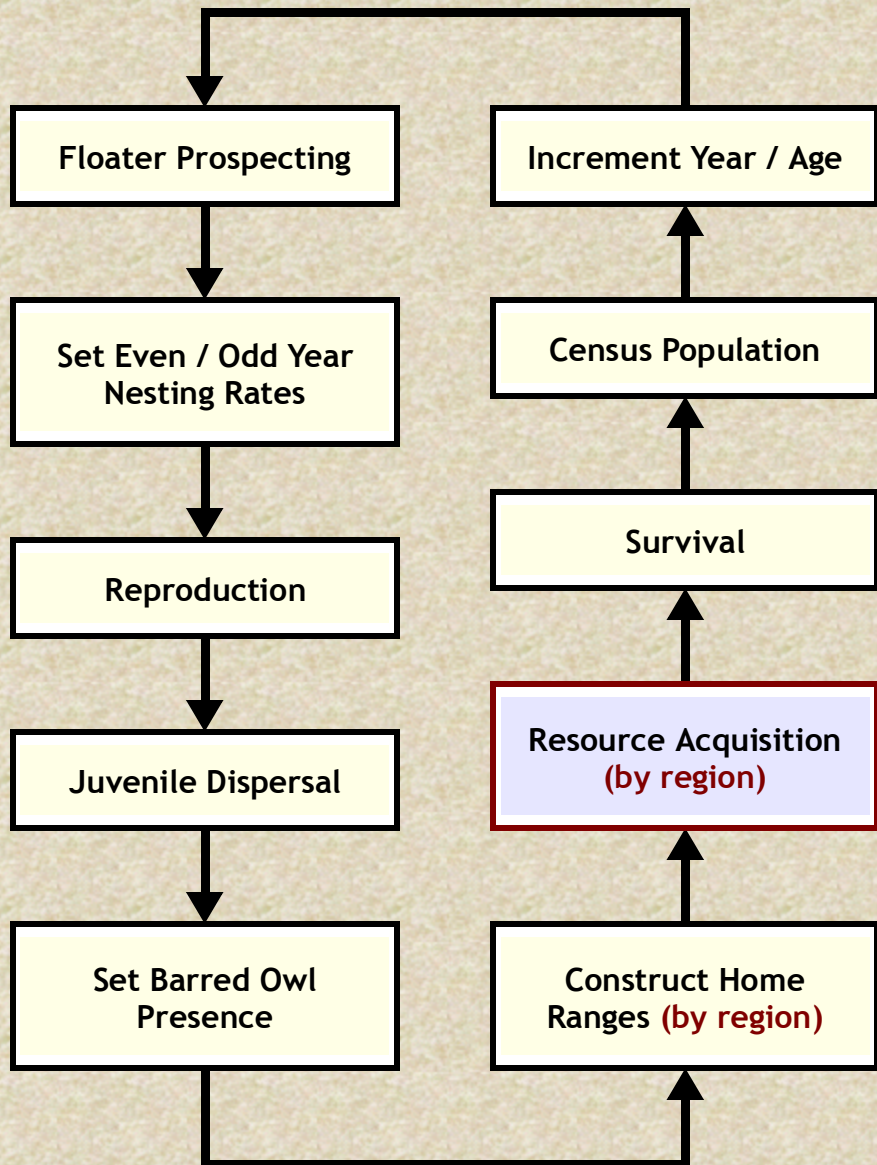
Barred Owl Impacts

- Barred owls affect NSO survival rates
- Stratified by region, otherwise non-spatial
- Barred owl impact is either on, or off
- Determination is made once per NSO



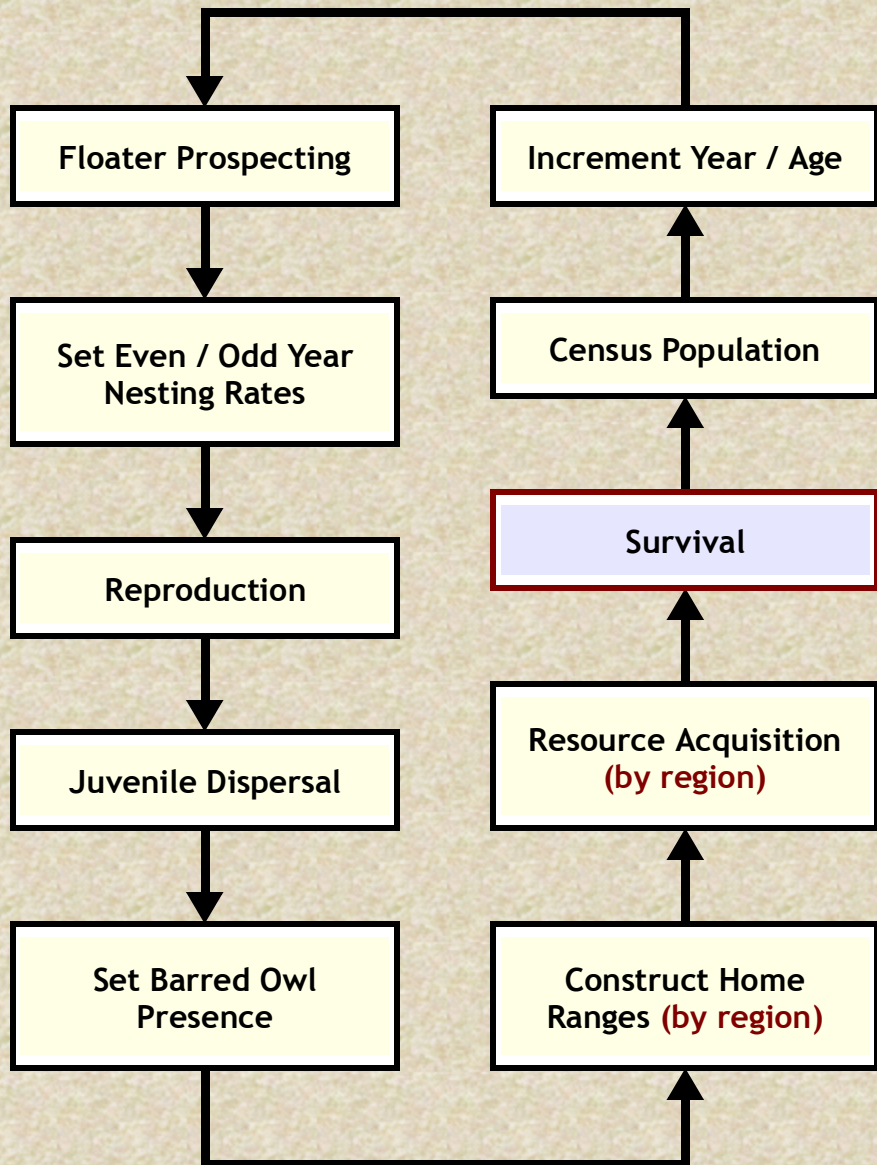
Home Range Construction

- Home ranges are allowed to overlap
- Home range size is stratified by region
- Owls share resources in overlapping ranges
- Search strategy is set to sub-optimal



Resource Acquisition

- ▣ Resources acquired from home ranges
- ▣ Individuals have equal competitive ability
- ▣ Owls assigned percent of a resource target
- ▣ Resource targets are stratified by region



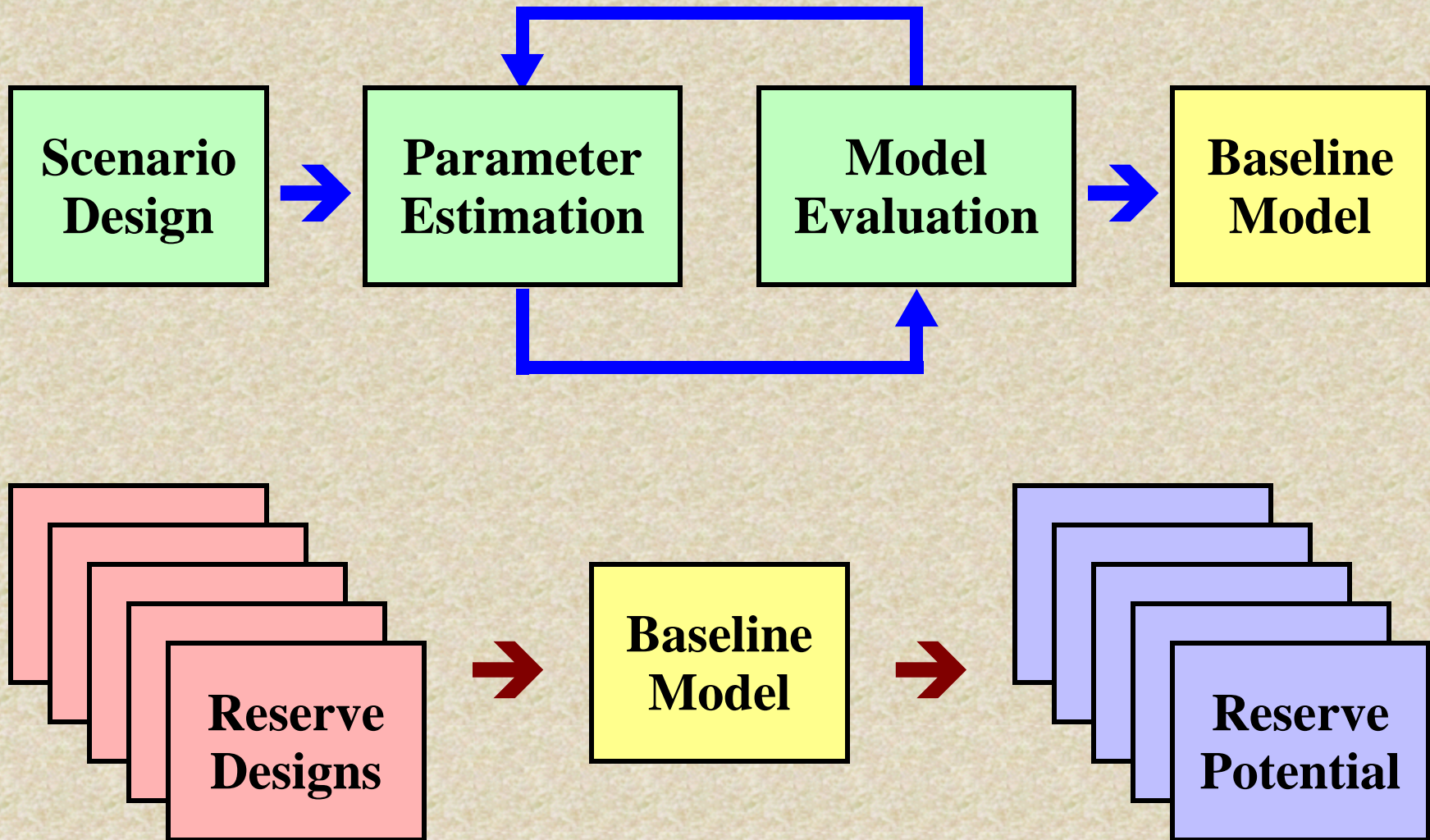
Survival

- ▣ Rates taken from Forsman et. al. (in press)
- ▣ Stratified by stage class, resources, barred owls
- ▣ Resource classes were low, moderate, high
- ▣ Barred owl impacts by Anthony & Dugger

Is our HexSim Model a Reasonable Approximation of Reality?

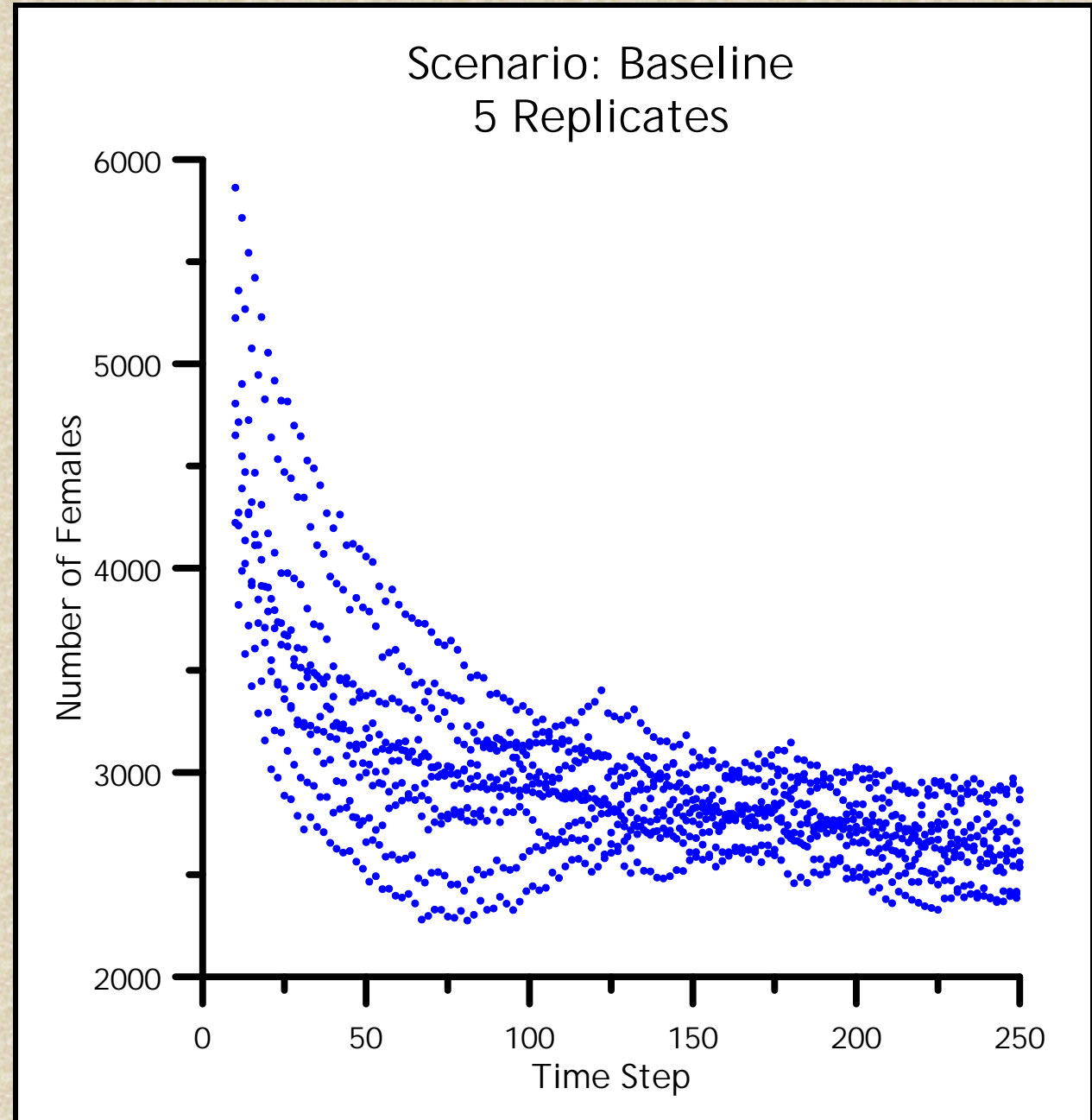
- The scenario is actually quite simple.**
- The life history events are parameterized using the latest data, and are conservative.**
- When uncertain, we left features out.**
- Our analysis plays to model strengths (for any model), such as relative change.**
- Our results are easily replicated by others.**

Using HexSim in the Analysis



Example Results

Population Size (with Barred Owl Effect)



Example Results

Population Size by Modeling Region

